

CENTRUM TECHNIKI OKRĘTOWEJ S.A.

Ship Design and Research Centre S.A.



AB 1241

RESEARCH AND DEVELOPMENT DEPARTMENT

ENVIRONMENTAL LABORATORIES DIVISION

VIBROACOUSTIC TESTS LABORATORY



NOTIFIED BODY
NB 2434

TEST REPORT

No RS-2018/B-216/E

Evaluation of sound absorption coefficient of absorbing panels with print PRINT by HUSH CREATIVE DESIGN GROUP

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Specimen No :

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1. Basic data

Tab. 1. Summary of data and test parameters.

Customer: HUSH CREATIVE DESIGN GROUP Spółka z ograniczoną odpowiedzialnością Sp. k. ul. Skolimowska 3 lok. 9 00-795 Warszawa	Order (e-mail): 21.03.2018									
	CTO S.A. order number: 8.478.05.223									
	Delivery date of test object: 06.04.2018									
	Date and place of measurements: 07.05.2018, Gdańsk, Ship Design And Research Centre Environmental Laboratories Division Acoustic Laboratory									
Name and type of test object: absorbing panels with print PRINT	The method of measurement and analysis of the results: According to the standards: - Standard No.: PN-EN ISO 354:2005 - Standard No.: PN-EN ISO 11654:1997									
Manufacturer: HUSH CREATIVE DESIGN GROUP Spółka z ograniczoną odpowiedzialnością Sp. k. ul. Skolimowska 3 lok. 9 00-795 Warszawa	<table><tr><th>Conditions of measurement</th><th></th></tr><tr><td>Air humidity</td><td>42,4 %</td></tr><tr><td>Temperature</td><td>21,4 °C</td></tr><tr><td>Atmospheric pressure</td><td>100,6 kPa</td></tr></table>		Conditions of measurement		Air humidity	42,4 %	Temperature	21,4 °C	Atmospheric pressure	100,6 kPa
	Conditions of measurement									
	Air humidity	42,4 %								
	Temperature	21,4 °C								
Atmospheric pressure	100,6 kPa									
Designation of the test object in CTO S.A.: LA1022										
Measuring equipment:	Channel 1	Channel 2								
measuring wires	0SvankK3	1SvankK3								
microphone	Norsonic 1225 Serial No. 284627	Norsonic 1225 Serial No. 285516								
preamplifier	Norsonic 1209 Serial No. 21138	Norsonic 1209 Serial No. 21137								
sound analyzer	Norsonic Nor 140 Serial No. 1406930	Norsonic Nor 140 Serial No. 1406929								
calibrator	Larson Davis, type CAL200, Serial No. 11524									
sound source	Larson Davis BAS001 Serial No. 1225-DIC08									
thermo-hygro-barometer	type LB-706BP, No. 846 type LB-701, No. 3605									
measuring tape	RS/0003									
Sound absorption results:										
Measured value	Actual value									
α_w - sound absorption coefficient	Tab. 4 and Tab. 5.									
Graph of sound absorption as a function of frequency and other relevant information is presented in a form compatible with the PN-EN ISO 354:2005 in chapter 5.										
Attention: Presented values are valid only for the tested object.										

2. Test method

Measurement of sound absorption of HUSH CREATIVE DESIGN GROUP absorbing panels with print PRINT was performed in reverberation chamber with a volume of 200 m³ in the Ship Design and Research Centre, in Acoustic Laboratory. Chamber specifications are placed in appendix No. 1. Reverberation chamber was tuned to achieve reverberation time required by the PN-EN ISO 354:2005. This was achieved by setting up 3 attenuator – diffusers and 8 diffusers. Their sound absorption area complies with Tab. 2.

Tab. 2. Equivalent sound absorption areas for a 200 m³ reverberation chamber for sound absorption coefficient measurements.

Frequency, Hz	100	125	160	200	250	315	400	500	630	800
A ₁ , m ² - Value measured in laboratory	4,2	4,0	4,6	4,8	5,5	5,6	5,6	5,6	5,8	5,9
A ₁ Max value acc. to norm	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
Frequency, Hz	1000	1250	1600	2000	2500	3150	4000	5000		
A ₁ , m ² - Value measured in laboratory	6,1	6,3	6,7	7,1	8,0	9,4	11,1	13,6		
A ₁ Max value acc. to norm	7,0	7,5	8,0	9,5	10,5	12,0	13,0	14,0		

Measurements were carried out for 12 microphone – sound source positions. Measurement in each position was repeated 3 times, in accordance with requirements in PN-EN ISO 354:2005. Test object was mounted directly on the floor of reverberation chamber, at a minimum distance of 1000 mm from the wall.

Test was carried out using sound analyzer Nor 140 by Norsonic and analysis was performed in „Nor 850 – Building Acoustics” application. Measurements were performed using methods in accordance with norm PN-EN ISO 354:2005. “Measurement of sound absorption in reverberation chamber.”

3. Description of the tested object

Absorbing panels with print PRINT manufactured by HUSH CREATIVE DESIGN GROUP, marked with the internal number LA1022 were tested.

Technical description

Tested were 4 sets of absorbing panels with print PRINT with dimensions of 2000x1350x40mm assembled on the floor (B102201) and with a distance of 30mm over the floor (B102202). Panels are made of aluminum frame filled with melamine foam absorbing sound, finished with a fabric imprinted on the front of the panel.

Photos of absorbing panels with print PRINT by HUSH CREATIVE DESIGN GROUP in reverberation chamber with volume of 200m³ in Acoustic Laboratory in CTO S.A., is presented in fig. 1.



Fig. 1. Test object LA1022, absorbing panels with print PRINT by HUSH CREATIVE DESIGN GROUP in reverberation chamber in Acoustic Laboratory in CTO S.A.

Arrangement of absorbing panels with print PRINT by HUSH CREATIVE DESIGN GROUP in reverberation chamber in CTO S.A is illustrated in fig. 3.

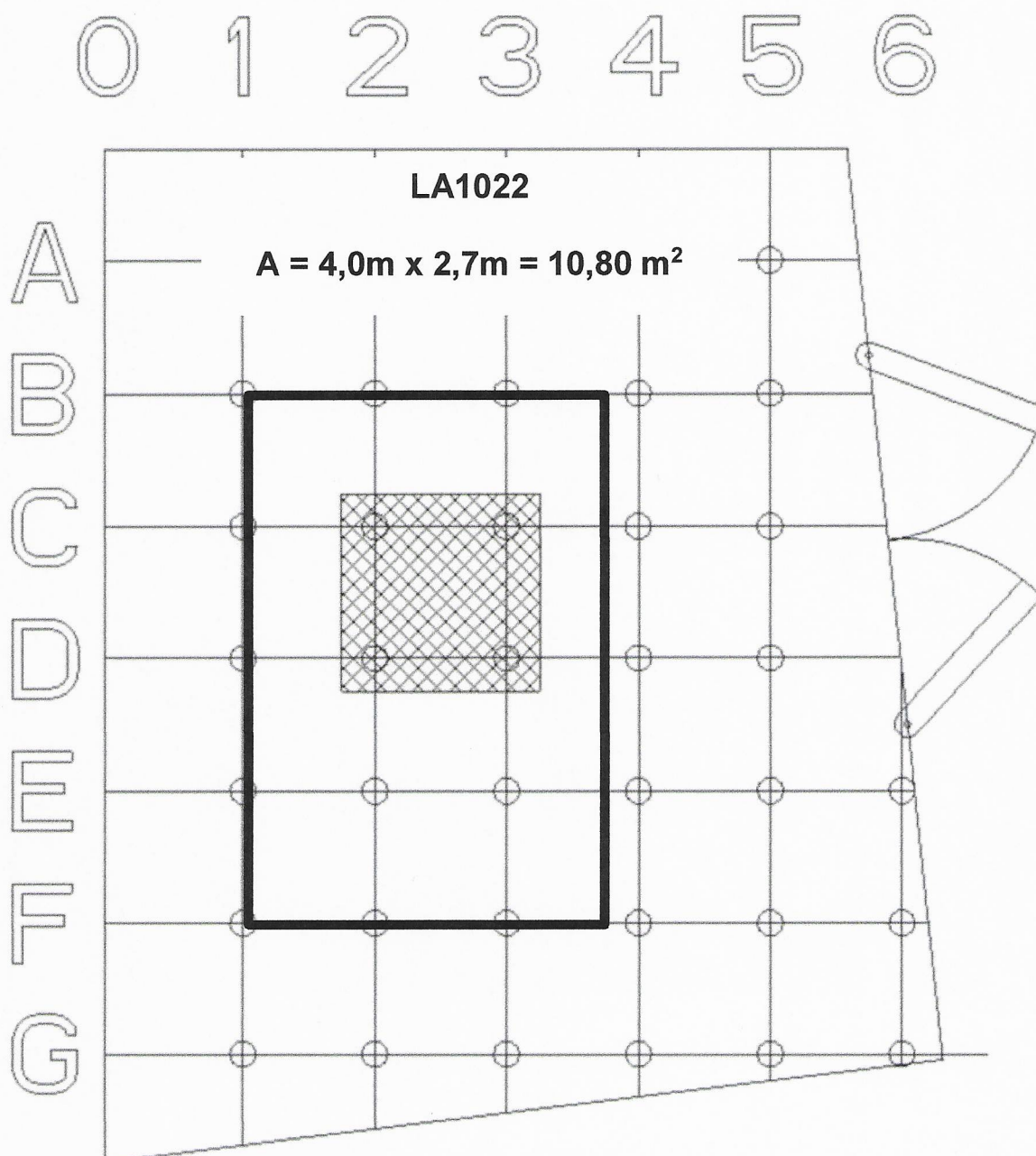


Fig. 2. Arrangement of absorbing panels with print PRINT by HUSH CREATIVE DESIGN GROUP in reverberation chamber in Acoustic Laboratory in CTO S.A.

Tested object designated as LA1022 with total area of $10,80\text{m}^2$ was placed in accordance with type "A" mounting on the floor of the reverberation chamber and 30mm above the floor, at a minimum distance of 1000mm from the walls of the reverberation chamber.

Tab. 3 shows schedule of the study.

Tab. 3. Schedule of the test

Test object designation	Step	Date
LA1022	Delivery date	06.04.2018
	Acclimatization	27.04 - 07.05.2018
	Installation	27.04.2018
	Measurement	7.05.2018
	Removal of the test object	7.05.2018

Test objects were acclimatized in reverberation chamber.

4. Measurement

Study was carried out in accordance with method described in PN-EN ISO 354:2005. Before the measurement, calibration of measuring channels was performed and conditions in reverberation chamber were written down. Test was done with two microphones in 6 positions and 2 positions of sound source. For each arrangement measurement was repeated 3 times. A total of 36 measurements was done for the test.

5. Analysis and summary of the test results

After the test, data from the analyser were uploaded to Nor 850 – Building Acoustics application and analysed. The analysis resulted with a graph showing sound absorption as a function of frequency in 1/3 octave band, together with reverberation time. The results are presented in tab. 4 and tab. 5. Sound absorption coefficient and sound absorption class in accordance with norm PN-EN ISO 11654:1997 are also shown in tab. 4 and tab. 5.

Tab. 4. Results of sound absorption measurements for test object LA1022 performed in acoustic laboratory in CTO S.A., in accordance with PN-EN ISO 354:2005.

Sound absorption coefficient according to norm PN-EN ISO 354:2005

Sound absorption measurement in reverberation chamber.

Client: HUSH CREATIVE DESIGN GROUP Spółka z ograniczoną odpowiedzialnością Sp. k. **Date of test:** 07.05.2018
 ul. Skolimowska 3 lok. 9; 00-795 Warszawa

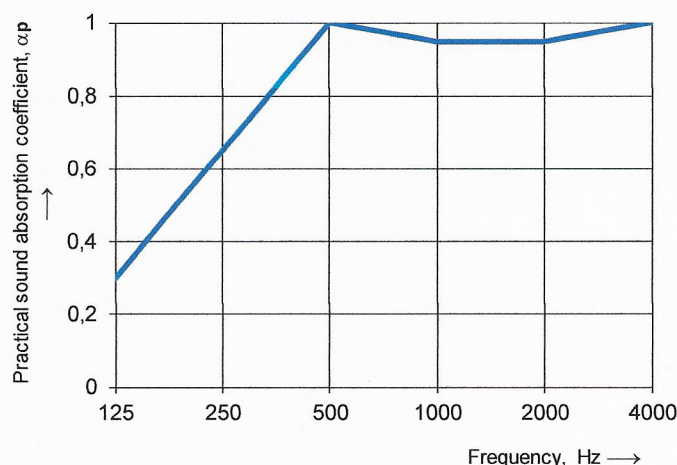
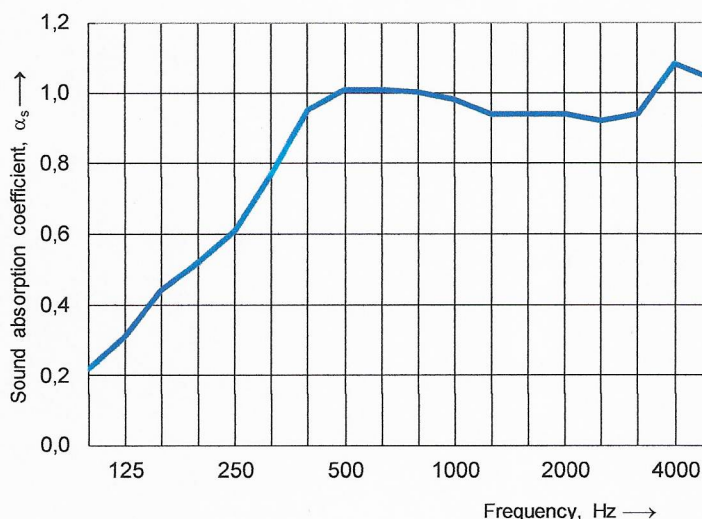
Test room identification: CTO S.A. Environmental Laboratories Division. Vibroacoustic Tests Laboratory.

Test object designation: LA1022

Description: 4 absorbing panels with print PRINT with dimension 2000x1350x40mm assembled on the floor. Panels are made of aluminum frame filled with melamine foam absorbing sound, finished with a fabric imprinted on the front of the panel.

Surface area of test object:	10,80 m ²	Empty reverberation chamber:		Reverberation chamber with test object:	
Volume of reverberation chamber:	200,0 m ³	Relative air humidity:	42,8 %	Relative air humidity:	42,4 %
		Air temperature:	21,2 °C	Air temperature:	21,4 °C
		Barometric pressure:	100,6 kPa	Barometric pressure:	100,6 kPa

Frequency f [Hz]	Empty T1 [s]	Object T2 [s]	α_s	α_p	A [m ²]
100	9,19	5,44	0,22	0,30	2,4
125	9,16	4,71	0,31		3,3
160	8,06	3,71	0,44		4,7
200	6,94	3,14	0,52	0,65	5,6
250	6,39	2,76	0,61		6,6
315	6,07	2,36	0,77		8,3
400	5,61	2,00	0,95	1,00	10,3
500	5,21	1,88	1,01		10,9
630	4,81	1,83	1,01		10,9
800	4,56	1,80	1,00	0,95	10,8
1000	4,31	1,78	0,98		10,6
1250	4,16	1,80	0,94		10,1
1600	4,01	1,77	0,94	0,95	10,2
2000	3,89	1,75	0,94		10,1
2500	3,49	1,68	0,92		9,9
3150	3,00	1,54	0,94	1,00	10,2
4000	2,72	1,37	1,08		11,7
5000	2,06	1,20	1,04		11,2



Sound absorption coefficient according to PN-EN ISO 11654:1997

 $\alpha_w = 0,95$ Sound absorption class: **A**

Test number: B102201

Date: 07.05.2018

Signature:

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Tab. 5. Results of sound absorption measurements for test object LA1022 performed in acoustic laboratory in CTO S.A., in accordance with PN-EN ISO 354:2005.

Sound absorption coefficient according to norm PN-EN ISO 354:2005

Sound absorption measurement in reverberation chamber.

Client: HUSH CREATIVE DESIGN GROUP Spółka z ograniczoną odpowiedzialnością Sp. k. **Date of test:** 07.05.2018
 ul. Skolimowska 3 lok. 9; 00-795 Warszawa

Test room identification: CTO S.A. Environmental Laboratories Division. Vibroacoustic Tests Laboratory.

Test object designation: LA1022

Description: 4 absorbing panels with print PRINT with dimension 2000x1350x40mm assembled with a distance of 30mm over the floor. Panels are made of aluminum frame filled with melamine foam absorbing sound, finished with a fabric imprinted on the front of the panel.

Surface area of test object: 10,80 m²
 Volume of reverberation chamber: 200,0 m³

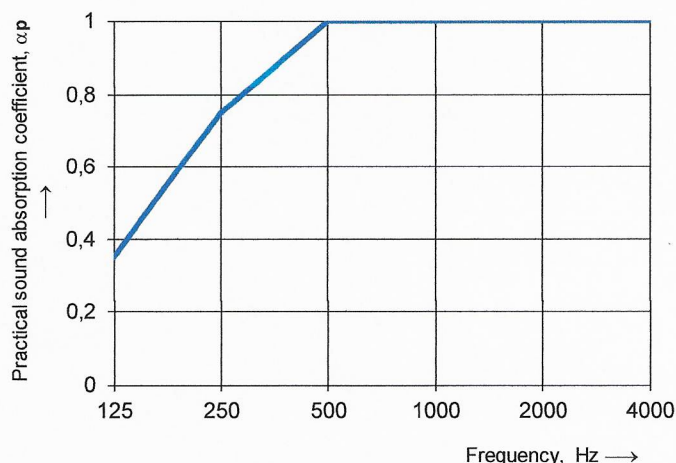
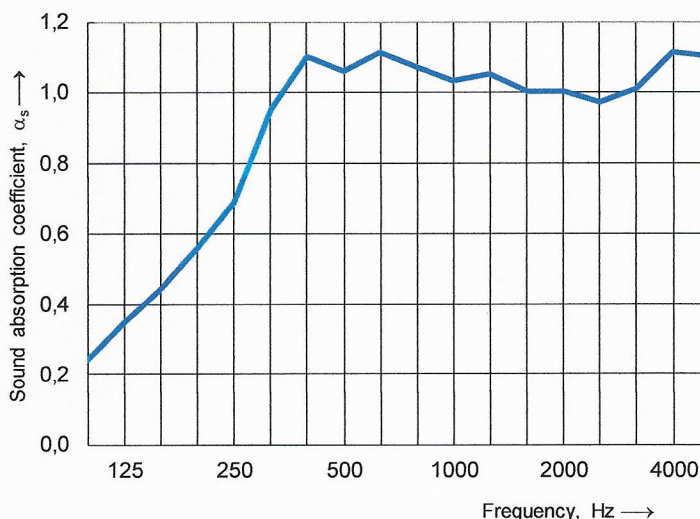
Empty reverberation chamber:

Relative air humidity: 42,8 %
 Air temperature: 21,2 °C
 Barometric pressure: 100,6 kPa

Reverberation chamber with test object:

Relative air humidity: 42,8 %
 Air temperature: 21,2 °C
 Barometric pressure: 100,6 kPa

Frequency f [Hz]	Empty T1 [s]	Object T2 [s]	α_s	α_p	A [m ²]
100	9,19	5,29	0,24	0,35	2,6
125	9,16	4,40	0,35		3,8
160	8,06	3,67	0,44		4,8
200	6,94	3,03	0,56	0,75	6
250	6,39	2,59	0,69		7,4
315	6,07	2,06	0,95		10,3
400	5,61	1,82	1,10	1,00	11,9
500	5,21	1,82	1,06		11,5
630	4,81	1,72	1,11		12
800	4,56	1,72	1,07	1,00	11,6
1000	4,31	1,73	1,03		11,1
1250	4,16	1,69	1,05		11,3
1600	4,01	1,71	1,00	1,00	10,8
2000	3,89	1,69	1,00		10,8
2500	3,49	1,63	0,97		10,5
3150	3,00	1,49	1,01	1,00	10,9
4000	2,72	1,35	1,11		12
5000	2,06	1,17	1,10		11,9



Sound absorption coefficient according to PN-EN ISO 11654:1997

 $\alpha_w = 1,00$ Sound absorption class: **A**

Test number: B102202

Date: 07.05.2018

Signature:

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1 appendix is attached to this test report:

- APPENDIX 1 - Configuration of reverberation chamber

Project Leader
*Head of the Vibroacoustic Tests
Laboratory*



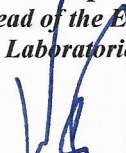
Dr Eng. Piotr Jakubowski
PJ – initials of report author

Authorised by
Vibroacoustic Specialist



MSc Magdalena Kuśmirek

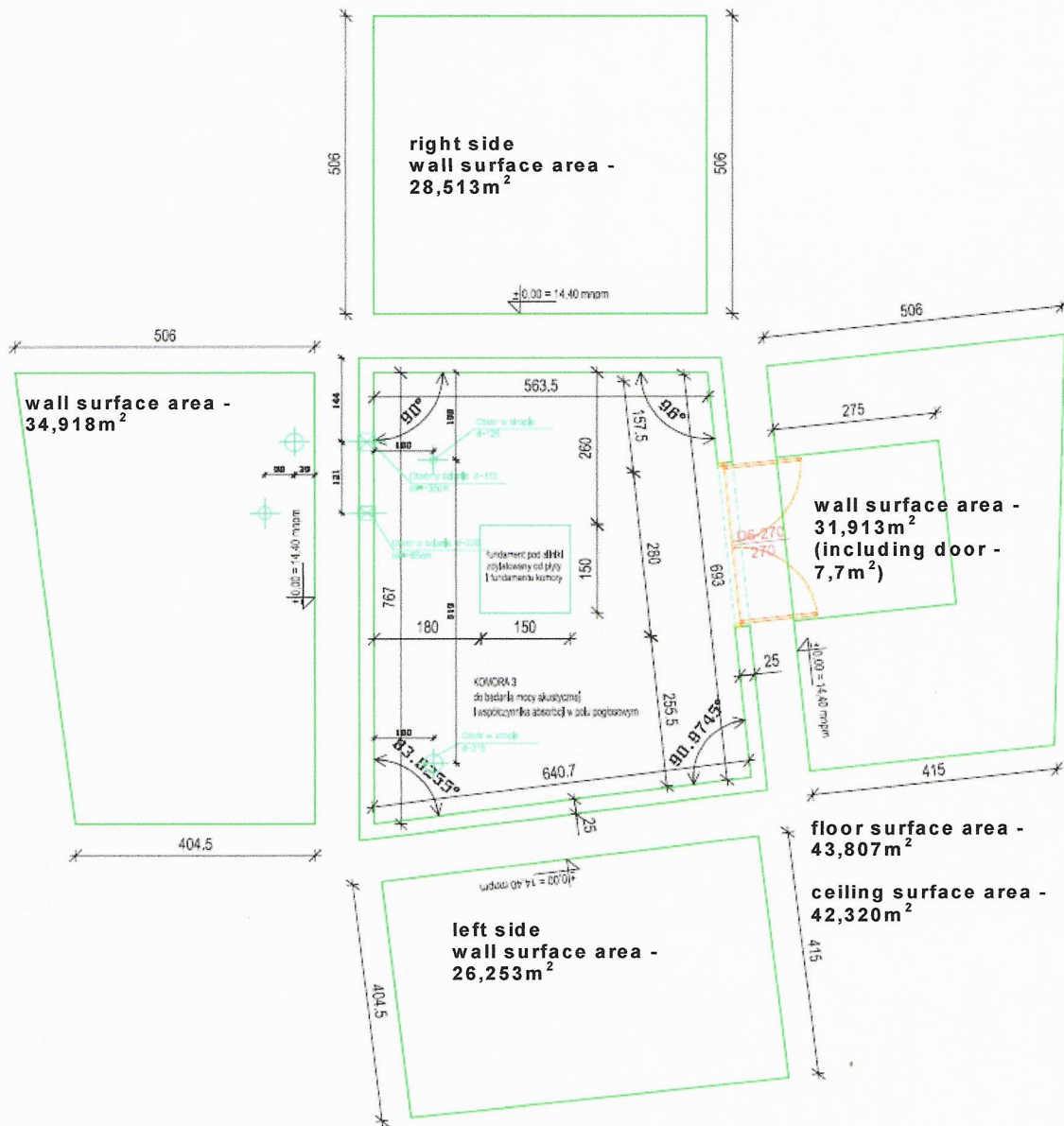
Supervisor
*Head of the Environmental
Laboratories Division*



Dr Eng. Mateusz Weryk

END OF REPORT

APPENDIX 1 – Configuration of reverberation chamber



Dimensions of the reverberation chamber for sound absorption coefficient α_s measurements.

Volume and wall surface areas of chamber No. 3

	Chamber	No. 3
volume	V [m³]	200,095
floor	S1 [m²]	43,807
ceiling	S2 [m²]	42,320
on the right	S3 [m²]	28,513
wall with door	S4 [m²]	31,913
on the left	S5 [m²]	26,253
opposite of the door	S6 [m²]	34,918
	total area [m²]	207,724

Diagonals of the reverberation chamber No. 3

Chamber No. 3 [m]
10,77
10,34
10,65
10,25